periment, i.e., explain why it was better to test a drug using a control group. In 1999, 26 percent of the survey respondents gave responses that met these criteria. (See figure 8-6 and appendix table 8-11.) In 1995 and 1997, the comparable percentages were 21 percent and 27 percent, respectively.

Public Attitudes Toward Science and Technology

In general, Americans express highly favorable attitudes toward science and technology. In the 1999 NSF public attitudes survey, overwhelming majorities agreed—and few disagreed—with the following statements:

- Science and technology are making our lives healthier, easier, and more comfortable (90 percent agreed and 9 percent disagreed).
- Most scientists want to work on things that will make life better for the average person (83 percent agreed and 15 percent disagreed).
- With the application of science and technology, work will become more interesting (73 percent agreed and 23 percent disagreed).
- Because of science and technology, there will be more opportunities for the next generation (84 percent agreed and 14 percent disagreed). (See appendix table 8-12.)

In a 1996 survey,

- Nearly half the respondents said that the terminology that best describes their reaction to science and technology was "satisfaction or hope"; 36 percent chose "excitement or wonder"; and only 6 percent answered "fear or alarm."
- More than half the respondents said that new developments in science and technology will have a positive impact on the overall standard of living in the United States; one-fifth thought the impact would be negative.
- Approximately four out of five respondents agreed that encouraging the brightest young people to go into scientific careers should be a top national priority (Roper 1996).

Despite these indicators, a sizeable portion—although not a majority—of the public has some reservations concerning science and (especially) technology. See sidebar, "Attitudes of Scientists, Legislators, and the Public Toward Science and Technology." For example, in the 1999 NSF survey, half of those queried agreed with the statement: "We depend too much on science and not enough on faith" (45 percent disagreed). And, about 40 percent agreed that "science makes our way of life change too fast" (57 percent disagreed). (See appendix table 8-12.)

Overall, however, there seems to have been a small, upward trend in positive attitudes toward science and technology. In general, data from the NSF survey show increasing percentages of Americans

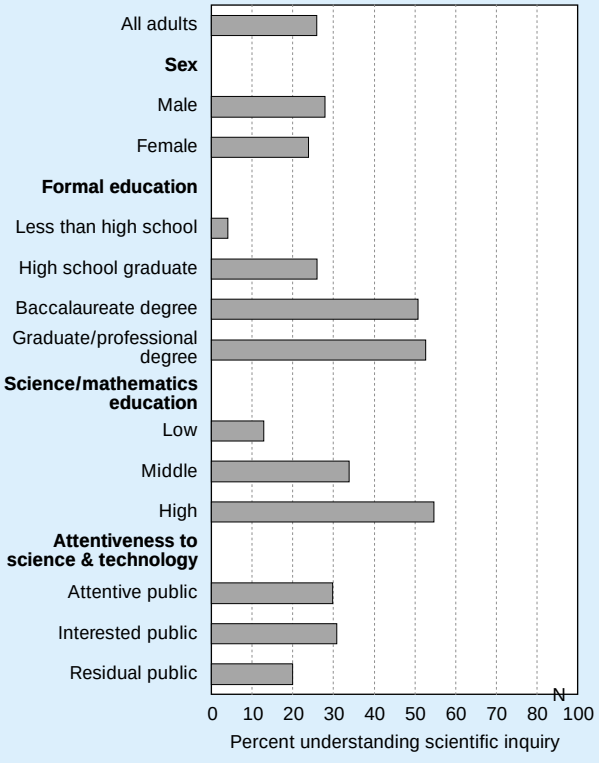
- *agreeing* that "science and technology are making our lives healthier, easier, and more comfortable" and
- *disagreeing* that "we depend too much on science and not enough on faith." (See appendix table 8-13.)

In addition, the survey results indicate that an increasing number of people believe that the benefits of scientific research outweigh any harmful results. (See the section "Perceptions of Scientific Research.")

The concern that does exist appears to be related to the impact of technology on society. For example, NSF survey respondents were fairly evenly split about whether "computers and factory automation will create more jobs than they will eliminate." (See appendix table 8-14.) And, a sizeable minority—46 percent—agreed with the statement that "people would do better by living a simpler life without so much technology." (See appendix table 8-15.) Also, about 3 out of every 10 people surveyed agreed that "technological discoveries will eventually destroy the Earth" and that "technological development creates an artificial and inhumane way of living." (See appendix tables 8-16 and 8-17.)

In a 1999 survey, more than half the respondents (55 percent) agreed with the statement, "Our growing reliance on technology is generally good because it makes life more convenient and easier." However, 39 percent of the respondents

Figure 8-6.
Public understanding of the nature of scientific inquiry: 1999



See appendix table 8-11. *Science & Engineering Indicators – 2000*

Attitudes of Scientists, Legislators, and the Public Toward Science and Technology

In a 1998 survey, researchers at the University of New Mexico Institute for Public Policy queried randomly selected individuals representing three groups—working scientists, members of state legislatures, and the general public—to find out their perspectives on nuclear security.* Included in the survey were several questions having to do with attitudes toward science and technology. Not unexpectedly, the scientists held more positive attitudes than members of the other two groups. For example, 83 percent of the scientists agreed that "science is the best source of reliable knowledge about the world"; about two-thirds of the legislators and members of the public also agreed with that statement. Responses to a question related to technology, however, showed a real difference of opinion. Forty percent of the respondents representing the general public agreed with the statement that "technology has become dangerous and unmanageable," compared with only 13 percent of the scientists and 15 percent of the legislators. (See figure 8-7.)

Responses to other questions revealed a general consensus among members of the three groups: slightly more than half the scientists and members of the public agreed that "science can eventually explain anything"; just under 50 percent of the legislators chose that response. Also, slightly more than half of each group disagreed with the statement "technology can solve most of society's problems."

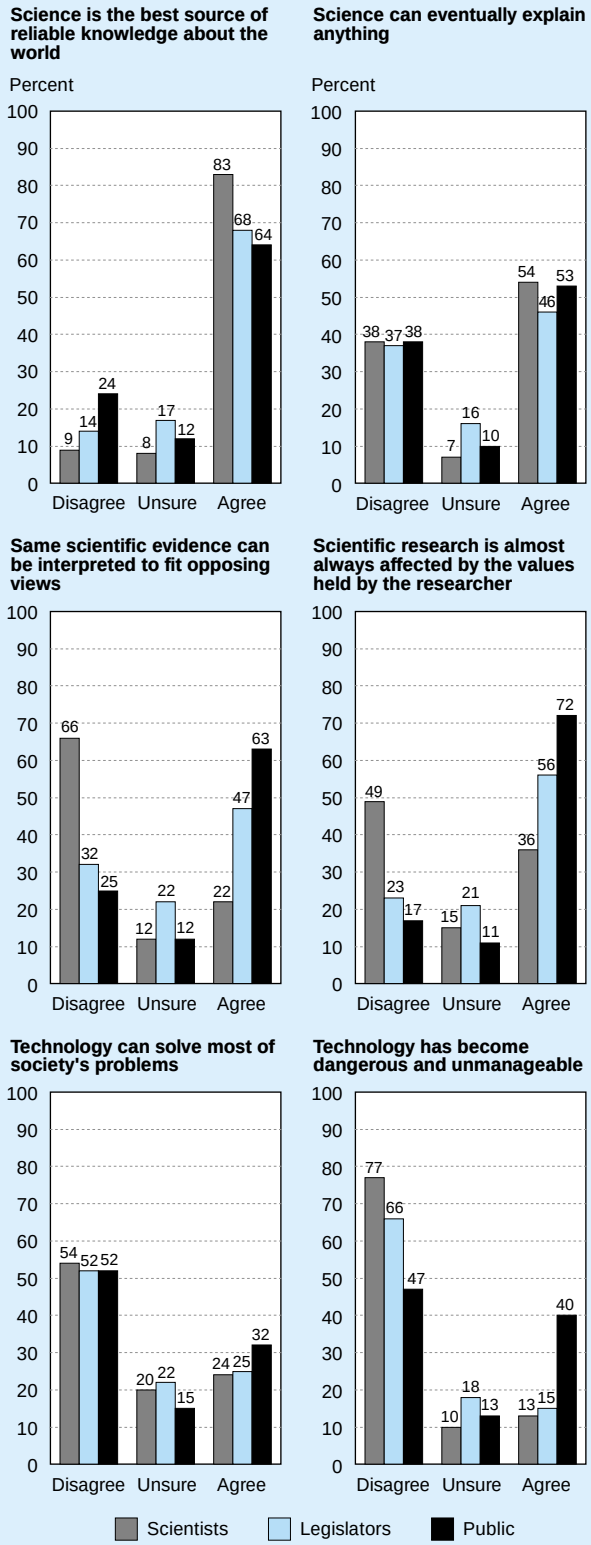
Two questions exposed very different attitudes toward the process of scientific inquiry: A majority of the public and approximately half the legislators agreed with the following statements:

- ♦ The same scientific evidence can almost always be interpreted to fit opposing points of view.
- ♦ The results of scientific research will almost always be significantly affected by the values held by the researcher.

In contrast, only 22 percent of the scientists agreed with the first statement, and 36 percent with the second.

*The response rates for the general public, the scientists, and the legislators were 54.8 percent, 53.8 percent, and 21.7 percent, respectively. Because the response rate for the legislators was less than half that of the other two groups, extensive nonresponse analysis was conducted. A comparison of views between legislator respondents and nonrespondents showed a significant difference on three survey questions. Data from those questions are not included in this sidebar. For more information on the nonresponse analysis, see Herron and Jenkins-Smith (1998).

Figure 8-7.
Attitudes of scientists, legislators, and the public toward science and technology: 1997



SOURCE: K.G. Hebron and H.C. Jenkins-Smith, *Public Perspectives on Nuclear Security* (Albuquerque, New Mexico: The University of New Mexico Institute for Public Policy, 1998), pp. 210–11, 213.

Science & Engineering Indicators – 2000

agreed with the other choice, "Our growing reliance on technology is generally bad because we will become too dependent on it and life will get too complicated." Those with higher incomes are more likely to have positive attitudes toward technology: 73 percent of the respondents reporting at least $75,000 in annual income chose the first statement, compared with only 46 percent of those reporting less than $20,000 (The Pew Research Center 1999a).

In another survey, more than half the respondents agreed that "science and technology [have] caused some of the problems we face as a society" (13 percent answered "most" of the problems). Responses to another question in the same survey were more positive: when asked to describe their "reaction when [they acquire] a new technical gadget, like a VCR…," nearly three out of five chose the response, "excitement at discovering what it can do"; another quarter of those surveyed picked "hope it will let you do things more easily." Only 6 percent feared they would not be able to use the new device, and 9 percent chose "indifference or lack of interest" (Roper 1996).

The Promise of Science—and Reservations

To track trends in public attitudes toward science and technology and to compare attitudes in the United States with those in other countries, an Index of Scientific Promise and an Index of Scientific Reservations were developed. In addition, the ratio of the Promise Index to the Reservations Index is a useful indicator of current and changing attitudes toward science and technology.[18]

Although a strong positive relationship exists between a person's level of education and favorable attitudes toward science and technology, both the Index of Scientific Promise and the Index of Scientific Reservations have remained fairly stable since 1992. However, it is noteworthy that the overall ratio of Promise to Reservations rose from 1.74 in 1995 to 1.89 in 1997. In 1999, the ratio was 1.87. (See appendix table 8-18.)

International Comparisons

North Americans and Europeans appear to have more favorable attitudes toward science and technology than the Japanese. At 55, Japan's mean score on the Index of Scientific Promise was considerably lower than that for the United States, the European Union, and Canada, all of which have scores close to 70. In all four sociopolitical systems, university-educated citizens have the most positive attitudes toward science and technology, whereas those who did not complete high school have less favorable attitudes. (See text table 8-3.)

U.S. residents seem to harbor fewer reservations about science and technology than their counterparts in the other three sociopolitical systems. The European Union, Japan, and Canada have similar Index of Scientific Reservations mean scores—all in the upper 50s—whereas the U.S. score was in the upper 30s.

In all four sociopolitical systems, individuals with the lowest levels of formal education expressed the highest levels of reservation about science and technology. The inverse relationship between education and reservations about science seems to be strongest in the United States. In addition, those who scored highest on measures of science literacy reported significantly lower levels of reservation about science and technology than those with less knowledge of science.

In all four societies, women were slightly more likely than men to hold reservations about science and technology. The disparities were small and may be attributable to differences in educational achievement.

Public Attitudes Toward the Funding of Scientific Research by the Federal Government

All indicators point to widespread support for government funding of basic research. In the 1999 NSF survey, 82 percent of those queried agreed with the following statement:

> Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the Federal Government.

Moreover, the level of agreement has been rising—and the level of disagreement falling—since 1992. (See appendix table 8-19.) During the mid-1990s, a gender gap in support for federally funded basic research seemed to be closing. In 1999, 84 percent of the men in the survey agreed with the statement cited above, compared with 80 percent of the women. (See appendix table 8-19.)

Support for federally funded basic research is closely tied to education level. In other words, the level of support rises with the level of formal education. In 1999, 72 percent of those surveyed who had not completed high school agreed with the statement; that percentage rose to 84 percent for high school graduates, to 87 percent for those with college degrees, and to 91 percent for those with graduate or professional degrees. (See appendix table 8-19.)

In addition, those with more positive overall attitudes toward science and technology were more likely to express support for government funding of basic research. In 1999, 90 percent of those who scored 75 or higher on the Index of Scientific Promise agreed that the Federal Government should fund basic scientific research, compared with only 61 per-

[18]The Index of Scientific Promise and the Index of Scientific Reservations are factor scores converted to a 0–100 scale. For each of the four countries or regions, a separate confirmatory factor analysis verified the existence of a two factor structure, and factor scores were computed for each dimension for each country or region. Within each country or region, the lowest possible factor score (strong disagreement with all of the items) was set to zero, and the highest possible factor score (strong agreement with all of the items) was set to 100. All factor scores between the highest and the lowest were placed on the 0–100 metric accordingly.

A core of items was identical in all countries and regions, and there was some minor variation in wording for some items from country to country. The strength of this factor analytic approach is that it allows the calibration of complete disagreement and complete agreement as end points on a 0–100 scale and creates a metric that is comparable across countries and regions. The questions used in the United States are described in the notes for appendix table 8-18; the questions used in Canada, Europe, and Japan are described in Miller, Pardo, and Niwa (1997).

cent of those with relatively low index scores. (See figure 8-8 and appendix table 8-20.)

Other studies have revealed similar favorable attitudes toward the government's role in supporting science and technology. In one survey, more than 80 percent of the respondents agreed that "the Federal Government has an important role to play in encouraging new developments in science and technology" and that "it is important that the United States be the world leader in technological progress" (Roper 1996). (See sidebar, "Americans Give High Marks to Government Investment in R&D.")

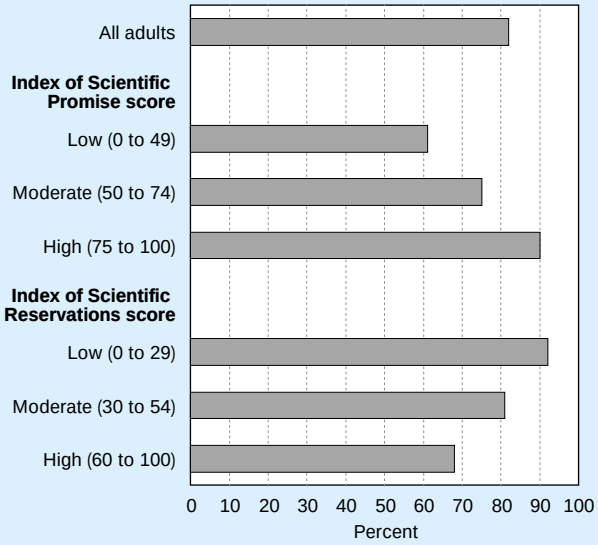
Only 14 percent of those who participated in the NSF survey thought the government was spending too much on scientific research; 37 percent thought the government was not spending enough. To put the response to this item in perspective, at least 65 percent of those surveyed thought the government was not spending enough on other programs, including reducing pollution, improving health care, improving educa-

Text table 8-3.
Index of Scientific Promise and Index of Scientific Reservations for the European Union, the United States, Japan, and Canada

Variable	Mean scores			
	European Union (1992)	United States (1995)	Japan (1991)	Canada (1989)
Scientific Promise				
All adults	69	68	55	72
Level of formal education				
Less than high school	68	63	54	68
High school graduate	69	68	55	75
Baccalaureate degree	71	71	56	84
Sex				
Male	70	69	55	76
Female	68	67	54	68
Civic scientific literacy				
Well informed	70	72	64	84
Moderately well informed	69	69	58	80
Not well informed	79	67	54	69
Attentiveness to science and technology policy				
Attentive public	74	74	56	79
Interested public	72	69	59	74
Residual public	67	65	54	69
Number of cases	6,122	2,006	1,457	2,000
Scientific Reservations				
All adults	58	39	56	56
Level of formal education				
Less than high school	64	51	62	60
High school graduate	57	39	55	52
Baccalaureate degree	53	27	50	40
Sex				
Male	57	38	55	53
Female	60	40	57	58
Civic scientific literacy				
Well informed	46	24	45	39
Moderately well informed	55	30	55	45
Not well informed	62	42	56	59
Attentiveness to science and technology policy				
Attentive public	57	30	54	45
Interested public	57	38	52	54
Residual public	60	42	57	59
Number of cases	6,122	2,006	1,457	2,000

SOURCE: J.D. Miller, R. Pardo, and F. Niwa, *Public Perceptions of Science and Technology: A Comparative Study of the European Union, the United States, Japan, and Canada* (Chicago: Chicago Academy of Sciences,1997).

Figure 8-8.
Support for government funding of basic scientific research, by level of general support for or reservations about science and technology: 1999



See appendix table 8-20. *Science & Engineering Indicators – 2000*

tion, and helping older people. In the survey, only exploring space and improving national defense had less support for increased spending than scientific research.[19] In fact, 46 percent of the respondents thought spending on space exploration was excessive, a higher percentage than that for any other item in the survey. (See appendix tables 8-21 and 8-22 and the section "Perceptions of Space Exploration.") It should be noted that few respondents really know what the government spends on various programs.[20]

International Comparisons

Government support for basic scientific research is at least as popular in Europe, Japan, and Canada as it is in the United States. In all four sociopolitical systems, the level of support has been about 80 percent or higher; the highest levels seem to be in Canada and Japan. (See text table 8-4.) In all four societies,

- The level of formal education and the level of scientific literacy were positively associated with support for government funding of basic scientific research.
- Those who expressed greater interest in science and technology were more supportive than those with less interest in those subjects.
- Men were slightly more likely than women to support government spending on basic scientific research.

Americans Give High Marks to Government Investment in R&D

Participants in a series of focus groups commissioned by several high-technology companies expressed strong support for government funding of R&D.* The consensus was that R&D should be considered a priority investment in the future quality of life and that R&D expenditures should not be cut to balance the budget (Public Opinion Strategies and Luntz Research and Strategic Services 1996).

Comments heard at sessions include:

- "Japan and Europe are investing heavily in 21st-century technology. If we don't keep pace, we'll be left behind."
- "If a technology is economically critical, the government should support R&D in that area."
- "Technological innovation doesn't just happen; we have to invest in it."
- "R&D keeps us militarily strong."

Although the focus group participants expressed support for strengthening government investment in both basic research and applied research, if they had to choose among competing priorities, they would give more emphasis to applied research projects because of their potential for leading to tangible payoffs in the more immediate future. According to the participants, government-funded R&D projects should:

- be a national priority,
- have potential benefit for a broad number of people,
- improve people's lives, and
- have a favorable cost–benefit calculation.

*The focus groups were held in 1996 in Lancaster, Pennsylvania (April 11), Columbus, Ohio (April 17), Houston, Texas (April 24), and New Orleans, Louisiana (April 25). The participants were selected for their awareness of current events and their interest in politics; they had a somewhat higher income and education level than the public at large and represented both political parties.

Public Confidence in the People Running Various Institutions

Public confidence in the leadership of various institutions has been tracked for nearly a quarter of a century (Davis and Smith annual series). Participants in the General Social Sur-

[19]Another poll also did not find high levels of support for increased science research funding (Wirthlin 1995).

[20]As an aside, in the First Amendment Center survey of journalists and scientists (see the section "The Relationship Between Science and the Media: Communicating with the Public"), respondents were asked what percentage of the total Federal budget is devoted to scientific research and technology development. The four choices were less than 1 percent, 1 percent to 10 percent, 11 percent to 20 percent, and more than 20 percent. Half the journalists and 65 percent of the scientists chose the correct response [1 percent to 10 percent; the actual figure is 4 percent (See chapter 2). Most of the rest of the survey participants guessed that less than 1 percent of the Federal budget is invested in science and technology.

Text table 8-4.
Approval of government support for basic scientific and technological research

Variable	Percentage strongly agreeing or agreeing			
	European Union (1992)	United States (1995)	Japan (1991)	Canada (1989)
All adults	80	78	86	88
Level of formal education				
Less than high school	67	67	81	85
High school graduate	83	79	86	89
Baccalaureate degree	89	87	93	98
Sex				
Male	83	79	90	91
Female	77	77	83	84
Civic scientific literacy				
Well informed	91	90	96	98
Moderately well informed	87	87	94	93
Not well informed	74	75	85	86
Attentiveness to science and technology policy				
Attentive public	91	83	89	92
Interested public	89	85	96	90
Residual public	73	70	84	84
Number of cases	6,122	2,006	1,457	2,000

SOURCE: J.D. Miller, R. Pardo, and F. Niwa, *Public Perceptions of Science and Technology: A Comparative Study of the European Union, the United States, Japan, and Canada* (Chicago: Chicago Academy of Sciences,1997). *Science & Engineering Indicators – 2000*

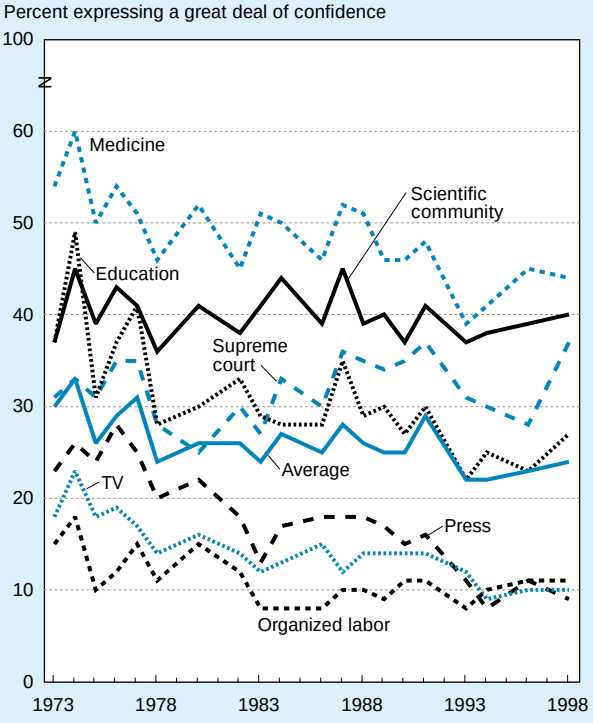
vey were asked whether they have a "great deal of confidence, only some confidence, or hardly any confidence at all" in the leadership of various institutions. In 1998, 40 percent reported that they had a great deal of confidence in the leadership of the scientific community. The only category that exceeded this vote of confidence was the medical community. Science has held the number two spot exclusively since 1978, overtaking education (for the last time) in that year. The Supreme Court, the military, education, major companies, and organized religion filled out the next five spots in 1999. The public has the least confidence in the press and TV; the "great deal of confidence" vote for the leadership of these institutions was 10 percent or less in 1998. (See figure 8-9 and appendix table 8-23.)

Interestingly, although the vote of confidence for the scientific community has fluctuated somewhat during the past quarter-century, it has remained about 40 percent. In contrast, there seems to have been an erosion in confidence in the medical profession. The rating for this group was once as high as 60 percent (1974); that percentage has been gradually declining for most of the past 25 years.

Perceptions of Scientific Research

By an overwhelming majority, Americans consistently believe that the benefits of scientific research outweigh any harmful results. Nearly half (47 percent) of the survey respondents said that the benefits *strongly* outweigh the harms, and another 27 percent said they *slightly* outweigh the harms. These percentages have been fairly stable for the past two

Figure 8-9.
Public confidence in leadership of selected institutions: 1973–98



See appendix table 8-23. *Science & Engineering Indicators – 2000*

decades, as has the percentage of respondents taking the opposite position. That is, between 10 and 20 percent of those queried believe the harms outweigh the benefits. (See figure 8-10 and appendix table 8-24.)

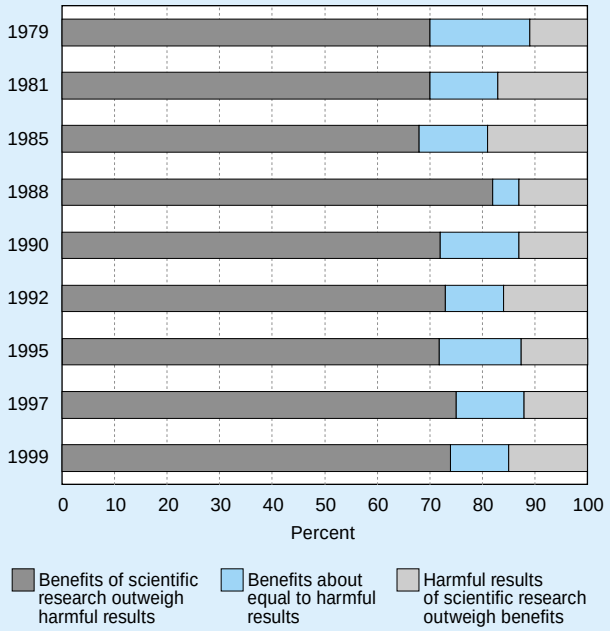
Men express greater surety than women that the benefits of scientific research outweigh the harmful results. In fact, 50 percent of the men in the 1999 survey, compared with 45 percent of the women, said that the benefits *strongly* outweighed the harms. Level of education is also strongly associated with a positive response to this question. Those who did not complete high school are more likely than those with more formal education to believe the harms outweigh the benefits, although it should be noted that half of this group said the benefits outweigh the harms. The comparable percentages for high school graduates and for those with at least a bachelor's degree were 78 percent and 90 percent, respectively, in 1999. (See appendix table 8-24.)

Perceptions of Nuclear Power

Americans are not as positive about all science and technology issues as they are about scientific research in general. For example, they have been evenly divided for more than a decade over the use of nuclear power to generate electricity. In 1999, 48 percent of Americans believed the benefits of nuclear power outweighed the harms, while 37 percent held the opposite view, and 15 percent thought that benefits and harms were equal. (See figure 8-11 and appendix table 8-25.)

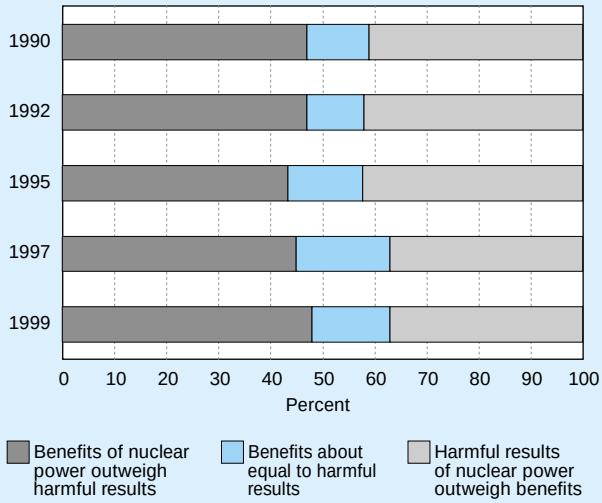
Individuals with more years of formal schooling, men, and those classified as attentive to science and technology policy are slightly more likely than others to believe the benefits of using nuclear power to generate electricity outweigh the harms. However, the correlation between education and attitudes toward use of nuclear power is relatively weak.

Figure 8-10.
Public assessment of scientific research: 1979–99 (selected years)



See appendix table 8-24. *Science & Engineering Indicators – 2000*

Figure 8-11.
Public assessment of nuclear power: 1990–99 (selected years)



See appendix table 8-25. *Science & Engineering Indicators – 2000*

Perceptions of Genetic Engineering

Data on public attitudes toward genetic engineering show no decline in the percentage of survey respondents who believe that the benefits outweigh the harmful results. In 1999, 44 percent of those interviewed agreed that the benefits either strongly or slightly outweigh the harms. (See figure 8-12 and appendix table 8-26.) This proportion is similar to that of the two previous surveys, despite the controversy generated by the widely reported news (in April 1997) about Dolly, the sheep cloned by a Scottish biologist and news (in January 1998) about a Chicago scientist planning to open a clinic for cloning people. (See sidebar, "The Most Closely Followed Science-Related News Stories: 1986–99.") Had the interviewers specifically mentioned cloning, the reaction from respondents may have been different, but the survey question did not include that word.[21]

The percentage of survey respondents who said that the harms outweighed the benefits was 38 percent in 1999. Among those classified as the attentive public for new medical discoveries (who may or may not be college graduates), the percentage agreeing that the harms are greater than the benefits rose from 30 percent in 1997 to 36 percent in 1999. (See figure 8-13.)

[21]In one poll, approximately 85 percent of the respondents said they oppose cloning human beings (Southern Focus 1998). In another poll, 69 percent of Floridians and 63 percent of Texans supported "research into the altering of human genes to treat disease" (Research! America 1999). Also, see sidebar, "Public Attitudes Toward Biotechnology."

Public Attitudes Toward Biotechnology

Before the recent controversy over genetically modified agricultural products erupted in Britain and other European countries, public opinion surveys on attitudes toward biotechnology were undertaken in Europe, Canada, and the United States.* Survey respondents were asked to assess the usefulness, risk, and moral acceptability of several applications of biotechnology and to say whether or not they would encourage each application (Miller *et al*. 1999).

Two sets of questions pertained to agricultural applications of biotechnology, including the use of genetic engineering in

- producing foods, for example, to make them higher in protein, allow them to keep longer, or change their taste, and
- making crops more resistant to insect pests.

Data collected with the three surveys show Europeans with less favorable attitudes than North Americans toward these two applications—in terms of all four criteria. The differences, however, were not large. For example,

- Fifty-five percent of the European survey participants agreed that genetically modified food is useful, compared with approximately two-thirds of the Canadian and U.S. respondents.
- Three-fifths of the Europeans agreed that genetically altered food is risky, compared with 55 percent and 53 percent of those in Canada and the United States, respectively.
- Half the Europeans said that genetically modified food is morally acceptable, compared with more than three-quarters of the Canadians and two-thirds of the Americans.
- Less than half the Europeans would encourage the production of genetically modified food, compared with nearly three-fifths of the North Americans.

The pattern of responses was similar for attitudes toward genetic modification of crops and other plants, although there seemed to be somewhat less support for this application of biotechnology. It is important to remember that the three surveys were conducted several years before the controversy surrounding genetically engineered food and crops made front-page headlines. Because the subject has received a considerable amount of press coverage, people may be better informed and have different opinions than those expressed when the surveys were conducted. (The author of the U.S. study noted that one of the problems in conducting a survey of public attitudes toward biotechnology is that many people do not have an attitude.)

Three sets of questions in the surveys pertained to medical applications of biotechnology:

- introducing human genes into bacteria to produce medicines or vaccines, e.g., to produce insulin for diabetics,
- using genetic testing to detect inherited diseases, and
- introducing human genes into animals to produce organs for human transplant, such as into pigs for human heart transplants.

The first two of these applications seem to have widespread public support in all three regions, although European support for medicine production lagged behind that of North Americans. However, European support for the genetic testing application was at least equal to that of the North Americans surveyed.

Attitudes toward the organ-transplant application were less favorable than those for the other two medical applications, with Europeans being somewhat more opposed than North Americans to this application, in terms of moral acceptability and whether or not the application should be encouraged.

*A 1996 Canadian survey, conducted by Professor Edna Einseidel, University of Calgary, used a national probability sample and included telephone interviews with 1,000 adults. The 1996 Eurobarometer on biotechnology was designed by a consortium of European scholars, organized and directed by Dr. John Durant of The Science Museum (London), and included personal interviews with 15,900 adults in the 15 member states of the European Union. A 1997 U.S. survey, directed by Professor Jon D. Miller, Northwestern University and the Chicago Academy of Sciences, used a national quota sample and included telephone interviews with 1,067 adults.

The relationship between a person's level of education and his or her assessment of the benefits and harms of genetic engineering shows some interesting trends. Although positive attitudes seemed to have increased (or stayed the same) between 1995 and 1999 for those without bachelor's degrees, the opposite seems to be true for those with degrees. The percentage of those in the latter group agreeing that the benefits outweigh the harms declined from 65 percent in 1995 to 55 percent in 1997, and then stayed the same in 1999. During the same period, among those with college degrees, the percentage saying the harms are greater than the benefits increased from 20 percent in 1995 to 24 percent in 1997 to 29 percent in 1999. (See figure 8-13.)

There is a significant gender gap in attitudes toward genetic engineering. Women are considerably more likely than men to believe the harms outweigh the benefits. In 1999, 42 percent of women agreed with this statement, compared with only 33 percent of men. The percentage-point difference has

been 7 or more in four of the past five NSF surveys. (See figure 8-13 and appendix table 8-26.)

Perceptions of Space Exploration

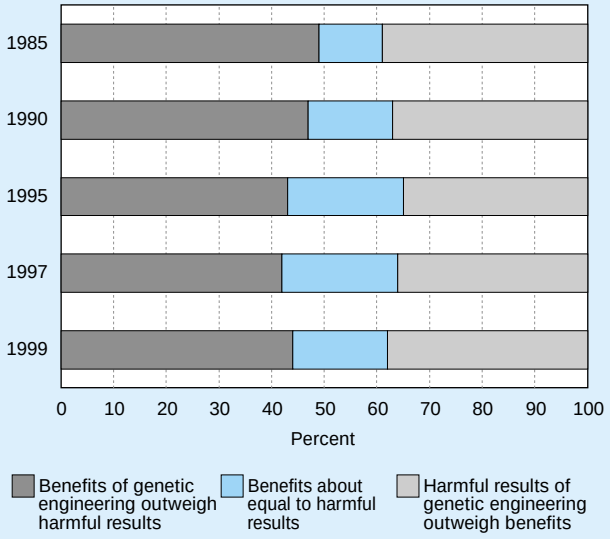
Before the Challenger accident, more than half the participants in NSF's public attitudes survey agreed that the benefits of space exploration exceeded the costs. Minds changed after the accident. The percentage agreeing that the benefits are greater than the costs fell from 54 percent in 1985 (before the explosion) to 47 percent in 1988 and to 43 percent in 1990. In the 1990s, this trend, an indicator of weakening support for the space program, leveled off. More recently, the percentage of survey respondents agreeing that the benefits are greater than the costs has been rising—from 43 percent in 1992 to 49 percent in 1999, approaching the 1985 level, before the Challenger accident. (See figure 8-14 and appendix table 8-27.)

In another poll, respondents were asked what they thought of the space program. More than half chose the response, "exciting and worthwhile"; 27 percent answered "only necessary to keep up with other nations"; and only 18 percent said it was "a waste of time and money." In response to another question, nearly half said that, in the future, the space program will make life on Earth better because of technological advances; 17 percent thought it would be worse because the money should have been spent on something else; and 32 percent thought the space program would not make life any better or worse (Roper 1996).

Like other issues, there is a sizeable gender gap in public assessment of space exploration. In fact, no other issue in the NSF survey has such a large disparity in opinion between the sexes. Men are more likely than women to champion the benefits over the costs. The gap was 14 percentage points in 1999.

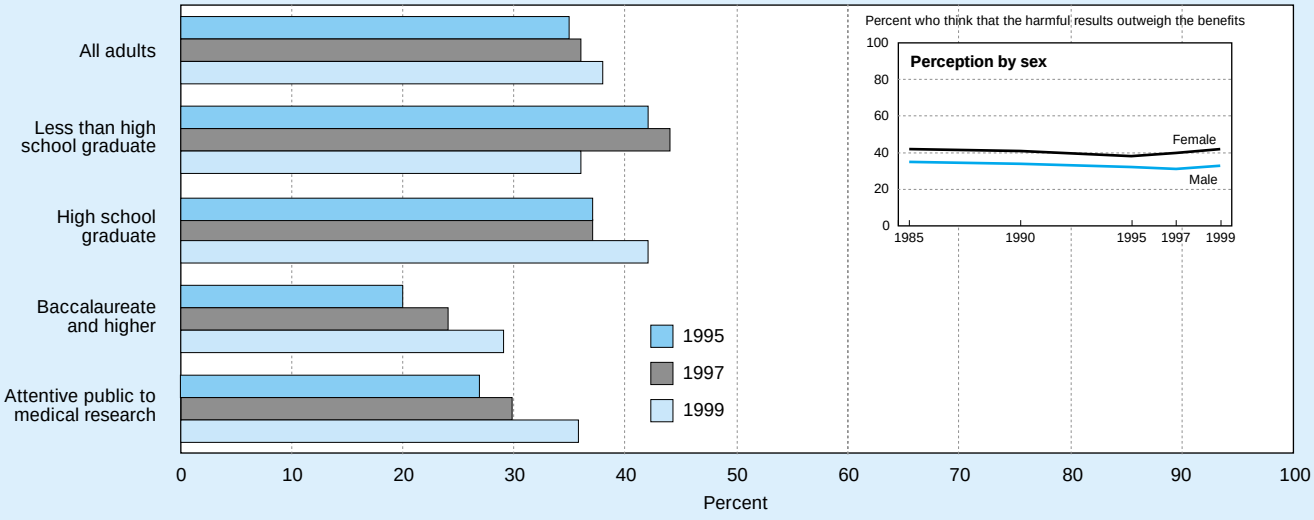
In every year but two (1990 and 1992), a majority of men interviewed for the survey agreed that the benefits outweigh the costs. The percentage stood at 57 percent in 1999, compared with 43 percent for women. In contrast, during the late 1980s and early 1990s, half or more of the women who participated in the survey thought that the costs exceeded the benefits. That is no longer true; the percentage dropped below 50 percent in 1997 and stayed there in 1999.

Figure 8-12.
Public assessment of genetic engineering: 1985–99 (selected years)



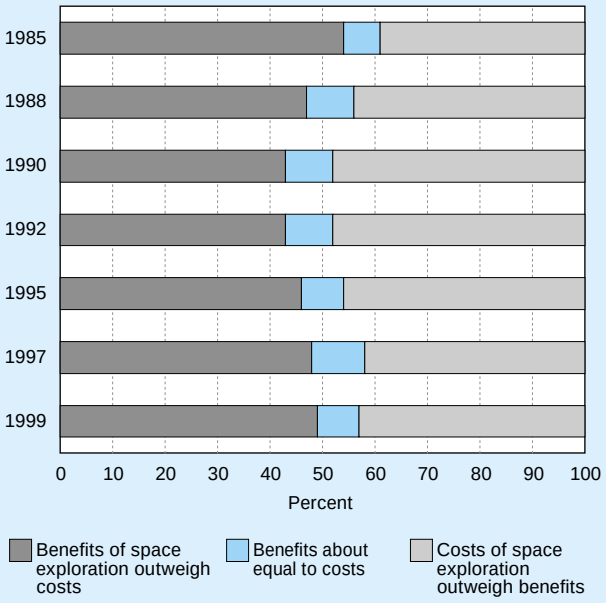
See appendix table 8-26. *Science & Engineering Indicators – 2000*

Figure 8-13.
Percentage of U.S. adults who view the harmful results of genetic engineering as outweighing the benefits: 1995, 1997, 1999



See appendix table 8-26. *Science & Engineering Indicators – 2000*

Figure 8-14.
Public assessment of space exploration: 1985–99 (selected years)



See appendix table 8-27. *Science & Engineering Indicators – 2000*

Those with more formal education are more likely than others to say that the benefits of space exploration exceed the cost. In 1999, only 40 percent of those with less than a high school education agreed that the benefits were greater than the costs, compared with 49 percent of those who graduated from high school and 60 percent of those with at least a bachelor's degree.

Those classified as attentive to science and technology—or to space exploration—are more likely than the public at large to believe that the benefits exceed the costs. At least 60 percent of each attentive group put the benefits ahead of the costs, compared with about half of the public at large.

Finally, about two-thirds of the public favor

- sending a U.S. manned mission to Mars (Roper 1996; and Southern Focus 1998) and
- building a space station (according to the NSF survey results).

Perceptions of the Use of Animals in Scientific Research

Few issues in science are as divisive as the use of animals in scientific research. There seems to be a 50–50 split in public opinion on this issue. (See appendix table 8-28.)

Public attitudes toward research using animals are shaped by:

- The purpose of the research. If animals are used in research on diseases such as cancer and AIDS, there is less opposition than if they are used in endeavors such as cosmetics testing.
- The type of animal. There is more tolerance for the use of mice in scientific experiments than for the use of dogs and chimpanzees.[22]
- The existence of alternatives, such as computer simulations. If they can accomplish the same purpose, then people will oppose the use of animals (Kimmel 1997).

Data from the NSF (and other) surveys show that:

- There was a slight increase in public opposition in the late 1980s.
- Compared with the citizens of other industrialized nations, Americans are more supportive of animal research (Kimmel 1997).

There are two major and long-standing fissures in public opinion on the use of animals in scientific research; that is, there are sex and age-related fault lines.

Women are far more likely than men to say they are opposed to the use of dogs and chimpanzees in scientific research. In 1999, nearly two out of every three women surveyed voiced opposition, whereas about one-third of the men held the same view. (See appendix table 8-28.) This gender gap in opinion cannot be attributed to differences between the sexes in science and mathematics education or differences in science literacy:

- At every education level, men are more likely than women to support the use of dogs and chimpanzees in scientific research. In 1995, 73 percent of men with graduate or professional degrees favored the use of these animals in scientific research, compared with 57 percent of the women in that educational category. For those with less than a high school education, the percentages were 59 percent and 45 percent, respectively.
- In addition, the number of science and mathematics courses taken is strongly related to men's attitudes toward animal research, but not at all related to women's attitudes.
- Among those classified as scientifically literate, 69 percent of the men, compared with only 48 percent of the women, expressed support for the use of dogs and chimpanzees in scientific research (Kimmel 1997).

Until the late 1990s, a fairly consistent relationship existed between age and attitudes toward animal research. Generally, the older the survey respondent, the more likely he or she was to express support for the use of animals in scientific research. It is widely assumed that the reason more positive attitudes are found among the elderly is that older persons

[22]Fewer people oppose the use of mice in scientific research; 30 percent of those surveyed opposed research on these creatures, compared with 47 percent who opposed research using dogs and chimpanzees. (See appendix tables 8-28 and 8-29.)

experience more health problems and therefore are more attuned to the need for medical research.[23]

In the past few years, the pattern has been less distinct. Now, all that can be said about the relationship between age and attitudes is that the 18- to 24-year-old age group is the *only* age group in which a majority opposes the use of dogs and chimpanzees in scientific research. (See figure 8-15.)

It is noteworthy that, for each age group, men are significantly more likely than women to support animal research. In no age group does a majority of women support the use of dogs and chimpanzees in scientific research.

Use of Computers and Computer Technology in the United States

There has been a marked increase in the number and variety of sources providing information about science and technology. (See chapter 9, "Significance of Information Technologies" and sidebar "Where Americans Get Information About Science and Technology.") Computers and computer technologies have become important in facilitating access to these new sources of information. According to the 1999 NSF survey, just over one-fifth of American adults have searched for science- or health-related information on the World Wide Web.

A number of indicators show the growing and widespread use of computers and computer-based technologies in the late 1990s. The increase in the number of home computers is particularly noteworthy.[24] In 1999, for the first time ever, a majority of American adults (54 percent) had at least one computer in their homes. The percentage has been rising steadily since 1983, when only 8 percent had them. (See figure 8-16 and appendix table 8-30.) In addition, among all adults,

- 46 percent had modems (for connection to the Internet) in their home computers, up from 21 percent in 1995;
- 45 percent had CD-ROM readers, up from 14 percent in 1995;
- 32 percent subscribed to an on-line service and had home e-mail addresses, up from 18 percent in 1997; and
- 17 percent had more than one computer in their homes, up from 12 percent in 1997. (See figure 8-17 and appendix table 8-31.)

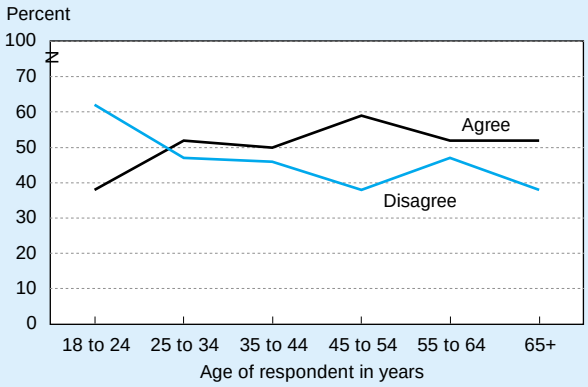
The average amount of time spent per year using a home computer rose from 103 hours in 1995 to 153 hours in 1999.

[23]It should be noted that the survey data are cross-sectional, rather than longitudinal. Although it can be assumed that, as adults age and experience more health problems, they become more receptive to the use of animals in scientific research, it is also possible that the older adults who participated in the survey have always been—throughout their lives—more supportive of animal research than the younger participants in the survey. Likewise, it is also possible that the current group of younger adults who participated in the survey will retain their higher level of opposition as they age.

One of the reasons for the high level of opposition to animal research among young adults is that animal rights groups, which distribute brochures to schools and use young celebrities to promote their cause, have been successful in influencing young people, especially girls. One study found that factors beyond educational achievement and science literacy, for example, a strong emotional component, account for the strong opposition among young women. Interestingly, this study revealed that the level of science achievement among girls who opposed animal research was higher than that for girls who favored animal research (Kimmel Pifer 1994).

[24]In a poll conducted in 1996, 43 percent of the respondents said they were very interested, and another 33 percent said they were somewhat interested, in learning more about computers. Among this same group of respondents, 45 percent thought that home computers would make it easier to do things like shopping, paying bills, making travel arrangements, and looking things up electronically instead of going to a library or buying books or newspapers; 16 percent thought using a computer would make doing these activities more complicated (Roper 1996).

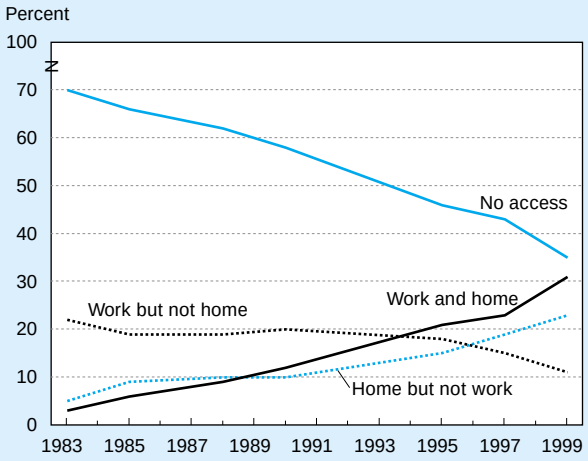
Figure 8-15.
U.S. public support for the use of dogs and chimpanzees in scientific research: 1999



NOTE: Responses are to the following question: "Scientists should be allowed to do research that causes pain and injury to animals such as dogs and chimpanzees if it produces new information about human health problems. Do you strongly agree, agree, disagree, or strongly disagree?"

See appendix table 8-28. *Science & Engineering Indicators – 2000*

Figure 8-16.
Public access to computers: 1983–99



See appendix table 8-30. *Science & Engineering Indicators – 2000*